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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/742,695	12/19/2003	Shaz Qadeer	3382-66774-01	4372

26119   7590   07/21/2008
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EXAMINER
ALHIJA, SAIF A

ART UNIT	PAPER NUMBER
2128	

MAIL DATE	DELIVERY MODE
07/21/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

	Application No.	Applicant(s)
Office Action Summary	10/742,695	QADEER ET AL.
	Examiner	Art Unit	
	SAIF A. ALHIJA	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) OR THIRTY (30) DAYS,
WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>13 March 2008</u>.

2a)☒ This action is **FINAL**.   2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
     closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) <u>1,3-16,18,21,23 and 24</u> is/are pending in the application.

   4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) <u>1,3-16,18,21,23 and 24</u> is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on <u>19 December 2003</u> is/are: a)☒ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
          application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO/SB/08)
   Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413)
   Paper No(s)/Mail Date. _____

5)☐ Notice of Informal Patent Application

6)☐ Other: _____.

DETAILED ACTION

1.   Claims 1 and 3-16, 18, 21, and 23-24 have been presented for examination.

           Claims 2, 17, 19-20, and 22 have been cancelled.

Response to Arguments

2.   Applicant's arguments with respect to claims 1 and 3-16, 18, 21, and 23-24 have been considered but are

moot in view of the new ground(s) of rejection.

NON PRIOR ART ARGUMENTS

           i)   Applicant argues the 101 rejections of claims 1 and 3-16, 18, 21, and 23-24. Following Applicants

arguments and amendments the 101 rejection of the claims are withdrawn.

           ii)   With respect to the request for interview the Examiner notes that Applicants representative did not

submit an interview request form with a proposed date, time, and agenda of the matters to be discussed nor was the

Examiner contacted directly. Furthermore a new rejection of the claims has been necessitated by Applicants

amendments and the new prior art of record has only just been presented to Applicants representative.

EXAMINERS NOTE

           iii)   Examiner has cited particular sections in the references applied to the claims for the convenience

of the applicant. Although the specified citations are representative of the teachings of the art and are applied to

specific limitations within the individual claim, other passages and figures may apply as well. It is respectfully

requested from the applicant in preparing responses, to fully consider the references in their entirety as potentially

teaching all or part of the claimed invention, as well as the context of the passage as taught by the prior art or

disclosed by the Examiner.

           iv)   The Examiner respectfully requests, in the event the Applicants choose to amend or add new

claims, that such claims and their limitations be directly mapped to the specification, which provides support for the

subject matter. This will assist in expediting compact prosecution.

           v)   Further, the Examiner respectfully encourages Applicants to direct the specificity of their response

with regards to this office action to the broadest reasonable interpretation of the claims as presented. This will avoid

issues that would delay prosecution such as limitations not explicitly presented in the claims, intended use

statements that carry no patentable weight, mere allegations of patentability, and novelty that is not clearly

expressed.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3.   **Claim 23 is rejected** under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

i)   The claim recites "wherein the resulting state is prior to the initial state." It is unclear what is meant by this phrase. This renders the claim vague and indefinite.

Appropriate correction is required.

All claims dependent upon a rejected base claim are rejected by virtue of their dependency.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1.   Determining the scope and contents of the prior art.
2.   Ascertaining the differences between the prior art and the claims at issue.
3.   Resolving the level of ordinary skill in the pertinent art.
4.   Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4.   Claim(s) 1 and 3-16, 18, 21, and 23-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over

Tyrrell et al. "CSP Methods for Identifying Atomic Actions in the Design of Fault Tolerant Concurrent

Systems", hereafter Tyrrell in view of Reps et al. "Precise Interprocedural Dataflow Analysis via Graph

Reachability", hereafter Reps.

Regarding Claim 1:

        Tyrrell discloses A computer program product embodied on a first computer readable medium and

comprising code that when executed causes a computer to perform a method of generating a partial procedure

summary of a procedure of multithreaded software, wherein the procedure performs a plurality of actions when

executed, the method comprising:

        1)   identifying a plurality of the actions as atomically modelable with respect to multithreaded

execution of the procedure as atomically modelable actions; **(Tyrrell. Page 630, Section II, Left Column, Last**

Paragraph, Concurrent Systems and Atomic Actions. Figure 1-2)

        2)   generating the partial procedure summary of the procedure from the plurality of the atomically

modelable actions, wherein the partial procedure summary comprises at least one state pair, wherein the at least one

state pair models an initial state and a resulting state of an atomically modelable action for the procedure, and

(Tyrrell. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 2.)

        Tyrrell does not explicitly disclose performing a reachability analysis of at least a portion **(Claim**

Interpretation. In response to Applicants arguments that performing the entire reachability analysis does not

anticipate the Examiner notes that the broadest reasonable interpretation of "at least a portion" encompasses

greater than 0% to less than or equal to 100%.) of the multithreaded software; when the procedure is reached

during the reachability analysis,

        the reachability analysis consulting the partial procedure summary to continue the reachability analysis.

        However Reps discloses performing a reachability analysis of at least a portion of the multithreaded

software; **(Reps. Page 54, Section 4, "realizable path reachability")**

when the procedure is reached during the reachability analysis, **(Reps. Page 54, Section 4, calledProc,**

profOf, and callers)

the reachability analysis consulting the partial procedure summary to continue the reachability analysis.

(Reps. Page 54, Section 4, "summary edges represent (partial) information about how the dataflow value

after a call depends on the dataflow value before the call.")

Reps and Tyrrell are analogous art in that they both deal with reachability graphs.

It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the

reachability analysis of Reps with the atomic modeling of multithreaded execution of Tyrrell in order to allow

for precise analysis. (See Reps Abstract, first line)

Regarding Claim 3:

The reference discloses The computer program product of claim 1 further comprising:

modeling execution of the software such that the state pair that comprises the partial procedure

summary is executed rather than the atomically modelable actions. **(Tyrrell. Page 630, Section II, Left Column,**

Last Paragraph, Concurrent Systems and Atomic Actions. Figure 1-2)

Regarding Claim 4:

The reference discloses The computer program product of claim 3 further comprising:

during modeling, comparing an indicated state invariant with a modeled state; **(Tyrrell. Figure 1-2. Page**

630, Left Column, Paragraph 2, "Thus all processes in the atomic action cooperate in error detection.")

responsive to determining the modeled state fails the indicated state invariant, indicating that a

programming flaw is present in the software, wherein determining the modeled state fails the indicates state

invariant comprises determining that a condition is false for at least one execution path. **(Tyrrell. Page 630, Left**

Column, Paragraph 2, "Thus all processes in the atomic action cooperate in error detection.")

Regarding Claim 5:

The reference discloses The computer program product of claim 1, wherein the resulting state comprises at least one of a plurality of possible states of the multithreaded software after execution of the modeled procedure, the method further comprising:

    storing an initial program counter location within the modeled procedure for the initial state;

    storing a resulting program counter location within the modeled procedure for the resulting state; and

    associating the initial program counter location within the modeled procedure and the resulting program counter location within the modeled procedure with the partial procedure summary. **(Tyrrell, Page 630, Section II, Left Column, Last Paragraph, Boundaries and entry/exit lines)**

Regarding Claim 6:

    The reference discloses The computer program product of claim 1,

    wherein the reachability analysis consulting the partial procedure summary further comprises determining possible execution paths within the procedure and using the procedure summary to explore possible states. **(Tyrrell, Page 630, Right Column, Section III, First Paragraph, Reachability Graph/Petri Net)**

Regarding Claim 7:

    The reference discloses The computer program product of claim 1 wherein the identifying comprises identifying a transaction boundary within the actions. **(Tyrrell, Page 630, Section II, Left Column, Last Paragraph, Boundaries)**

Regarding Claim 8:

    The reference discloses The computer program product of claim 1 wherein the identifying comprises identifying at least one of the plurality of actions as movable later in time with respect to actions executed by other threads without affecting a resulting end state.**(Tyrrell, Page 631, Left Column, Paragraph 3, Timelines and Time Critical Systems)**

Regarding Claim 9:

The reference discloses The computer program product of claim 1 wherein the identifying comprises identifying a sequence of actions having zero or more right movers followed by an atomic action   followed by zero or more left movers. **(Tyrrell. Page 630, Section II, Left Column, Last Paragraph, Atomic Actions. Page 632-634, Algorithms/Interleaving and Elements S/F/K)**

Regarding Claim 10:

The reference discloses The computer program product of claim 1 wherein the plurality of actions atomically with respect to multithreaded execution of the software is a subset of the plurality of actions of the procedure, the subset comprising less than all of the plurality of actions of the procedure. **(Tyrrell. Page 632-634, Algorithms/Interleaving and Elements S/F/K)**

Regarding Claim 11:

Tyrrell discloses A computer program product embodied on a computer readable medium and comprising code that when executed causes a computer to perform a method of modeling multithreaded software, the   method comprising:

analyzing actions of the multithreaded software within the procedure such that actions that can be executed atomically are determined based on the analyzing, generating a plurality of procedure summaries for the multithreaded software, the plurality of procedure summaries comprising respective start and end actions for the determined actions executed atomically, **(Tyrrell. Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. See Also Reps, Definition 2.1 reciting "start node" and "exit node")** and

wherein the procedure summaries comprises a plurality of modeled states of the multithreaded software for multithreaded execution of the multithreaded software. **(Tyrrell. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)**

However Tyrrell does not explicitly disclose performing a reachability analysis of the multithreaded software;

during the reachability analysis, reaching a procedure;

during the reachability analysis, again reaching the procedure and reusing the plurality of procedure

summaries to determine actions executable atomically;

However Reps discloses performing a reachability analysis of the multithreaded software; **(Reps. Page 54,**

Section 4, "realizable path reachability")

during the reachability analysis, reaching a procedure; **(Reps. Page 54, Section 4, calledProc, profOf, and**

callers)

during the reachability analysis, again reaching the procedure and reusing the plurality of procedure

summaries to determine actions executable atomically; **(Reps. Page 54, Section 4, "summary edges represent**

(partial) information about how the dataflow value after a call depends on the dataflow value before the call"

as well as "each iteration of main loop in procedure …" is analogous to the reuse. Page 49, Section 1.i,

"atomic dataflow")

Reps and Tyrrell are analogous art in that they both deal with reachability graphs.

It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the

reachability analysis of Reps with the atomic modeling of multithreaded execution of Tyrrell in order to allow

for precise analysis. (See Reps Abstract, first line)

Regarding Claim 12:

The reference discloses The computer program product of claim 11 wherein at least one of the

procedure summaries comprises at least two or more partial procedure summaries summarizing a procedure.

(Tyrell. Page 633, Figure 3-4. Parallel processing and interleaving summaries.)

Regarding Claim 13:

The reference discloses The computer program product of claim 11 wherein at least one of the procedure

summaries comprises at least one partial procedure summary for a procedure, wherein the partial procedure

summary summarizes less than all of the procedure. **(Tyrell. Claim Interpretation. A summary by definition is**

less than what it summarizes. Page 633, Figure 3-4. Parallel processing and interleaving summaries.)

Regarding Claim 14:

The reference discloses The computer program product of claim 11 wherein the evaluating comprises:

identifying a series of transactions within the multithreaded software; **(Tyrell. Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)** and

modeling the transactions via partial procedure summaries. **(Tyrell. Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)**

Regarding Claim 15:

The reference discloses A computer-implemented system for modeling multithreaded software, the system comprising:

a model checker operable to analyze a model of the multithreaded software via checking the model of the multithreaded software for programming flaws,**(Tyrell. Section III discusses error detection, as well as the Abstract and intent of the reference dealing with error detection as well as recovery. Further the last paragraph of Section I states the placement of "fault tolerance software structures" as well as the references discussion of multiple processes)** the model checker comprising:

the model of the multithreaded software, wherein the model comprises a plurality of procedure summaries modeling states of the multithreaded software during multithreaded execution of the multithreaded software the procedure summaries comprising the start and end states of sets of actions atomically modelable with respect to multithreaded execution of the software; **(Tyrell. Page 630, Section II, Left Paragraph, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)** and

a reachability analyzer operable to employ the procedure summaries instead of the sets of actions to generate modeled states of the software. **(Tyrell. Page 630, Section II, Left Paragraph, Last Paragraph, Concurrent Systems and Atomic Actions. Page 633, Figure 3-4. Parallel processing and interleaving summaries. Figure 1-2)**

Regarding Claim 16:

The reference discloses The computer implemented system of claim 15 wherein at least one of the

procedure summaries comprises a procedure summary summarizing actions deemed to have occurred one after

another without interruption. **(Claim Interpretation. Actions occurring without interruption is the definition of**

an atomic action. Tyrell. Page 630, Section II, Left Column, Last Paragraph, Concurrent Systems and Atomic

Actions. Figure 1-2)

Regarding Claim 18:

The reference discloses the computer implemented system of claim 16 wherein the system is operable

to detect programming flaws via comparing an indicated state invariant with the modeled states. **(Tyrell. Page**

630, Left Column, Paragraph 2, "Thus all processes in the atomic action cooperate in error detection.")

Regarding Claim 21:

The reference discloses. The computer program product of claim 1, wherein the at least one state pair

comprises an initial state of the procedure and at least one of a plurality of possible states of the multithreaded

software after execution of the modeled procedure. **(See rejection for claim 1)**

Regarding Claim 23:

The reference discloses The computer program product of claim 1, wherein the resulting state is prior to

the initial state. **(See 112 2nd rejection above)**

　　　　(Tyrell. Page 635, bottom right, "result := SequentiallyPostDependent")

　　　　(Reps. Figure 4)

Regarding Claim 24:

Tyrell and Reps do not explicitly recite The computer program product of claim 1, wherein the partial procedure summary of the procedure of multithreaded software is embodied on a second computer readable medium.

However it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize a second computer readable medium for purposes of modularity.

Conclusion

5.   Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

6.   All Claims are rejected.

7.   Any inquiry concerning this communication or earlier communications from the examiner should be directed to SAIF A. ALHIJA whose telephone number is (571)272-8635. The examiner can normally be reached on M-F, 11:00-7:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamini Shah can be reached on (571) 272-22792279. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information

Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR

or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more

information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the

Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SAA

July 12, 2008

/Michael D Masinick/

Primary Examiner, Art Unit 2128